

observations made in 1877 shows that with these precautions the effects of screw errors must have been confined within very small limits even in individual observations, and in the results of three or four observations must be practically insensible, and this result is confirmed by the comparison which I have given between the Cape Catalogue 1860 and the Cape Catalogue 1880. The larger errors which appear in Mr. Gill's Tables VII. and VIII. have nothing to do with the systematic errors of the Cape Catalogue 1880, for the simple reason that the threads of the screws to which they apply were not used in the work.

Mr. Gill's idea appears to be that I was bound to make observations over the whole range of the screws, whether the threads were defective or the screws under constraint or not, and then to attempt to determine the errors of these screws and to apply corrections to the results. I preferred to avoid the large errors altogether, and I have done so. Every attempt to carry out Mr. Gill's ideas into practice with the Cape screws would have ended in a disastrous failure. The change of error is so rapid about the 0^r (or Mr. Gill's 5^r) that the errors of the screws could not be determined with any great accuracy, or applied with any certainty subject to such shifts of adjustments as are inevitable in practical work. But whether Mr. Gill's ideas might have been practically carried out or not, I was certainly entitled to carry out my own ideas, which I knew would lead to results of very considerable accuracy. I have carried them out, and I am satisfied with the result.

Note on the Descriptions of two Stars in Ptolemy's Catalogue.

By E. B. Knobel.

In the first printed edition of the *Almagest*, which is that published in Latin by Liechtenstein at Venice in 1515, the descriptions of the 8th star in *Scorpio* (*a Scorpii*) and the 2nd star in *Orion* (*a Orionis*) are as follows:—

8. *Scorpio*. "Media earum quæ tendit ad rapinam quæ dicitur Cor Scorpionis."
2. *Orion*. "Lucida quæ est super humerum dextrum et ipsa tendit ad rapinam quia * appropinquat ad terram in humero Orionis."

Baily remarks in his compiled edition of *Ptolemy's Catalogue*, "There is a singular expression in the edition of Liechtenstein that I am unable to explain. It first occurs in the constellation *Scorpio*, and is repeated in the constellation *Orion*, where the star is described as "tendens ad rapinam."

It is well known that the Liechtenstein *Almagest* is derived

* Baily translates the abbreviation in Liechtenstein as "quæ," but Mr. Scott, Assistant-Keeper of MSS. British Museum, tells me it is undoubtedly "quia."

from Arabic sources. There is abundant internal evidence to prove this; notably in Dictio VII. cap. i., where Arabic names are given to stars, which in the Greek *Almagest* are without names; the proper name Hipparchus is spelt "Abrachis," after the manner of the Arabs, and in the Catalogue many Arabic names are given to the stars and constellations.

I have, however, recently made a close comparison between this printed edition and three Latin MS. *Almagests* of the fourteenth and fifteenth centuries, which are copies of the translation from the Arabic by Gerard of Cremona (A.D. 1114-1187); and from the numerous passages compared being verbatim the same, and particularly from the same blunders and mistakes being common to them all, I think there can be no doubt whatever that the Liechtenstein *Almagest* is simply the printed edition of Gerard of Cremona's translation. Weidler makes the following remark about it. "Sed interpretis nomen non adscribitur nec in præfatione et epilogo memoratur. Collata vero utraque versione apparet hanc Venetam ex Arabico traductam fuisse, et a Trapezuntiana permultum differre."*

The MSS. referred to are the following:—

British Museum, Sloane MS., 2795. Date, circa 1300, possibly earlier.

British Museum, Burney MS., 275. Date, circa 1387.

Latin MS., No. 148-9, belonging to the Earl of Crawford and Balcarres. Date, sæc. XV.

The descriptions of the two stars in question in these three MSS. and the Liechtenstein *Almagest*, are verbatim the same, with the exception that the printed edition alone adds to one of them the words "quia appropinquat ad terram in humero Orionis."

Thinking that some light might possibly be thrown upon the meaning of the sentence "tendens ad rapinam" by examining the original Arabic, I have consulted and obtained extracts from four different Arabic MSS. found in the British Museum, the Bodleian Library, and the Library of the India Office. These MSS. are:—

British Museum, Additional MSS., 7475. *Almagest*, date A.H. 615=A.D. 1218. This MS. is written in a very cursive character, with a lamentable neglect of diacritical points, which renders it very difficult to decipher.

Bodleian Library, Pococke 369 (Uri 888). *Almagest*, date A.H. 799=A.D. 1396.

British Museum, Additional MSS., 7488. "Al Sūfi, Description of the Stars." Date, sæc. XV. or XVI. A fairly well written MS., with very good drawings of the constellations.

India Office Library, No. 2389. "Al Sūfi, Description of the Stars."

* Baily says "the name of the translator of the Liechtenstein *Almagest* not known, nor is it stated whence the MS. was obtained."

The last-named MS. has been kindly examined for me by Dr. J. W. Redhouse, who has taken great trouble to elucidate and solve a difficulty in the translation.

The following descriptions of these stars comprise all the original MSS. and works I have been able to examine:—

8th Star in Scorpio.

1. Greek *Almagest*.

ὁ μέσος αὐτῶν καὶ ὑπόκιρρος καλούμενος ἀντάρης.

2. Latin *Almagest* from Greek (Trapezuntius).

Media ipsarum et subruffa quæ vocatur Antares.

3. Latin *Almagest* from Arabic (Gerard of Cremona).

Media earum quæ tendit ad rapinam quæ dicitur Cor Scorpionis.

4. Arabic *Almagest*. Brit. Mus. Add. MSS., 7475.

الكوكب الأوسط منها و هو قلب العقرب و هو شمعى و يسمى بالرومي انطرس

The middle star of them, and it is *Cor Scorpionis*, and it is wax-like, and is named in Greek *Antares*.

5. Arabic *Almagest*. Bibl. Bodl. Pococke, 369.

الأوسط منها الذي الخوصي و هو قلب العقرب

The middle one of them, which (is) ? and it is *Cor Scorpionis*.

6. Al Sūfi. Arabic MS. Brit. Mus. Add. MSS., 7488.

الأوسط منها الذي يضرب الي الخوض و يقال لم قلب العقرب

The middle one of them, which inclines to ? and is named *Cor Scorpionis*.

7. Al Sūfi. Arabic MS. India Office, No. 2389.

الأوسط منها الذي يضرب الي الخوض و يقال له قلب العقرب

(Nearly identical with Brit. Mus. MS.)

8. Al Sūfi. Schjellerup's translation.

Leur mitoyenne qui tire sur le rouge يضرب الي الخوصي
nommée قلب العقرب le cœur du Scorpion.

9. Ulugh Beigh. Hyde's translation from Persian.

Media trium quæ magna est ac rufa. Kalb Al Akrah.

2nd Star in Orion.

1. Greek *Almagest*.

ὁ ἐπὶ τοῦ δεξιῶ ὤμου λαμπρὸς ὑπόκιρρος.

2. Latin *Almagest* from Greek (Trapezuntius).

Splendida quæ in humero dextro et est subruffa.

3. Latin *Almagest*, from Arabic (Gerard of Cremona).
 "Lucida quæ est super humerum dextrum et ipsa tendit
 ad rapinam." Liechtenstein's printed edition adds,
 "quia appropinquat ad terram in humero Orionis."
4. Arabic *Almagest*. Brit. Mus. Add. MSS. 7475.
 الكوكب النضي الشمعي الذي علي المنكب اليمين
 The bright star wax-like, which is upon the right shoulder.
5. Arabic *Almagest*. Bibl. Bodl., Pococke, 369.
 النير الذي علي المنكب اليمين وهو يضرب * الي الحوصي
 * (Copyist's error for يضرب)
 (Identical with Al Sūfi.)
6. Al Sūfi. Arabic MS. Brit. Mus. Add. MSS. 7488.
 النير الذي علي المنكب اليمين وهو يضرب الي الحوص
 The bright (star) which is on the right shoulder inclining to ?
7. Al Sūfi. Arabic MS. India Office.
 النير الذي علي المنكب اليمين وهو يضرب الي الحوص
 (Identical with Brit. Mus. MS.)
8. Al Sūfi, Schjellerup's translation.
 La brillante qui est sur l'épaule droite et qui tire sur le
 rouge يضرب الي الحوصي
9. Ulugh Beigh. Hyde's translation.
 Stella lucida in humero dextro quæ ad rubedinem vergit.

All these descriptions, with the exception of No. 3 by Gerard of Cremona, contain some word which is intended, probably, as a translation of the Greek *ὑπόκιρρος*, to express the colour of the star.

But there is a marked and singular difference in the Arabic authorities.

In the British Museum *Almagest* the four principal red stars of Ptolemy, *α Tauri*, *β Geminorum*, *α Scorpii*, and *α Orionis*, described by Ptolemy as *ὑπόκιρρος*, are designated شمعي (shamāie), which means "like wax," from شمع (wax).^{*} This is a satisfactory explanation of the enigmatical words "et est cerea," which Liechtenstein uses in the descriptions of the 14th star of *Taurus* (*α Tauri*), and the 2nd star in *Gemini* (*β Geminorum*), and which have been always a puzzle to students of the *Almagest*.

In the Bodleian *Almagest*, however, the corresponding word

* It should be noted that the Bodleian *Almagest* describes the colour of three of these stars as well as *Sirius*, by the sentence يضرب الي الحوصي

is **الخصوي**, and in this MS. and the two MSS. of Al Sūfi as well as in Schjellerup's translation we have the following variations:—

| | | | | |
|---------------|--------------|--------------|---------------|---------------|
| الحرّة | الحرض | الحوض | الخصوي | الخصوي |
| El harah. | El harad. | El hūd. | El chūsi. | El hūsi. |

The general resemblance of all these words suggests errors in copying.

The word **الخصوي**, el hūsi, in the Bodleian *Almagest*, has no meaning, and must be an error of the scribe. It is not found in any of the other MSS.

Prof. Schjellerup, in his Al Sūfi, gives Ptolemy's correct description to the stars in question, and also to the red star *a Tauri*, but he appends the Arabic word **الخصوي**, which he translates "rouge," or "rougeâtre." Dr. Rien, the Keeper of Oriental MSS. at the British Museum, and Dr. Redhouse inform me there is no such Arabic word implying colour. In fact, Prof. Schjellerup translates the word as it ought to be, his Arabic MS. having an untranslatable word.

In the British Museum MS. of Al Sūfi the word **ὑπόκιρρος** in *β Geminorum* and *Antares* is in each case translated **الحوض**, el hūd, and the same word is used in the India Office MS. in the descriptions of the 2nd star in *Gemini* and the 2nd in *Orion*. There appears to be no known meaning to this word implying colour.

Dr. Redhouse considers that the word **الحرض**, el harad, which he finds in the description of the 8th star in *Scorpio* (and which I have also found in the British Museum MS. of Al Sūfi in the description of the 2nd star in *Orion*), is the real word, of which the others are only copyists' errors. He gives the meaning of **الحرض**, el harad, as "sallowness of complexion, pallor," which is in fair agreement with **ὑπόκιρρος**, "somewhat yellow;" and also with the expression "et est cerea," "wax-like;" the identical word in Arabic for which **شمعي** is found in the British Museum *Almagest*.

This explanation may be the true one, but there is the fifth word, **الحرّة**, el harah, which I find in the British Museum MS. of Al Sūfi in the description of the 14th star in *Taurus*, and which Dr. Redhouse finds also used for the same star in the India Office MS. He infers that this is meant for **الحمرة**, el

hamra, "redness." The word **الحرّة** is derived from **حر**, meaning "heat," "fierce," "fiery," and this meaning is clearly applicable to the stars in question. It is quite obvious that all the words are intended to express the colour of the star.

It is by no means clear what the word was which Gerard of

Cremona translated as “rapina,” the Arabic for which *الذئب* not resembling any of the variations given. The arrangement and construction of his sentence closely resembles the Bodleian *Almagest*, and is the exact translation (except this one word) of the several copies of Al Sūfi. The verb in these MSS. is *يُتَرَبِّى*, which corresponds exactly with “tendens” in Gerard of Cremona, and “vergit” in Hyde’s *Ulugh Beigh*. It is not an improbable suggestion that Gerard of Cremona found in his MS. the same untranslatable word which I have found in the MSS. quoted; and one case being the principal star of *Scorpio*, “the accursed constellation and the baleful source of war and discord,” and the other, the principal star of *Orion*, who was held to “portend tempests and misfortune,” he translated it by the word “rapine,” having the *astrological* significance of these constellations and of these particular stars. And, as has been suggested to me by Dr. Garnett, Liechtenstein’s addition of “quia appropinquat ad terram in humero Orionis,” was a continuation of the astrological idea erroneously started by the mistranslation by Gerard of Cremona of *الحوصي*, or one of the words given above.

With regard to the British Museum Arabic *Almagest* it appears to differ from the Bodleian *Almagest*, so as to indicate a different translation from the Greek.

I have taken out from this MS. the positions of stars in many of the constellations, and have found a very singular mistake made by the original translator of the MS. from the Greek. The number 60 is expressed in Arabic by the letter *س*. Seen, but it is curious that the letter *ص*, Sād, which signifies 90, has always been put for the *س*. So a translator would record the latitudes of many stars as 90 and odd degrees instead of 60 and odd.

This mistake is rather inexplicable, but it appears that the numerical value of the letters of the alphabet is remembered among the Arabs by certain fictitious words as follows:—

| | |
|-------------------------|------------------------|
| <i>هـ-و-ز</i> Huz, | <i>ا ب ج د</i> Abjad, |
| 7, 6, 5, | 4, 3, 2, 1, |
| <i>ك-ل-م-ن</i> Kalman, | <i>ح-ط-ي</i> Hati, |
| 50, 40, 30, 20, | 10, 9, 8, |
| <i>ق-ر-ش-ت</i> Karshat, | <i>س-ع-ف-ص</i> Sāfas, |
| 400, 300, 200, 100, | 90, 80, 70, 60, |
| <i>ظ-ط-غ</i> Dathagh, | <i>ث-خ-ذ</i> Thakhath, |
| 1000, 900, 800, | 700, 600, 500, |

In the case in question, the scribe, wanting the character for 60, would remember the word “sāfas,” which begins and ends with an S sound, and he has taken the last S instead of the first.

Less easy is it to explain a more curious mistake which occurs in both Latin MSS. of the *Almagest* of Gerard of Cremona at the British Museum, and with precisely the same stars as the above error in the Arabic *Almagest*. The latitudes of 34 stars in the Catalogue are given as 300 and odd degrees instead of 60 and odd * degrees. Here the translator must have confounded the س, Seen, =60, with the ش, Sheen, =300, and given the numerical value of the latter letter to the former.

1885, January 7.

Note on the Periodic Time of a Centauri.

By A. M. W. Downing, M.A.

In the *Monthly Notices* for November last there is an interesting paper by Mr. Powell on the periodic time of a Centauri, in which he contends that the period of this celebrated binary—for our knowledge of the orbital motion of which we are so much indebted to his own observations—cannot, in all probability, be less than 86 or 87 years. Into the reasons which have induced Mr. Powell to come to this conclusion I do not propose to enter on the present occasion, and will content myself with saying that it appears to me that the only test of an orbit is to compare it with *observations*; and that, as far as I can judge, a period of about 76 years will stand this test as well as can be reasonably expected, taking into account the insufficient means of observation employed for the earlier measures, and the difficulty of making accurate observations, on account of the proximity of the stars, in some of the later ones. In order to show this agreement in some extreme cases, I have compared the position-angles computed from the orbit, published in the *Monthly Notices* for March 1884, with the individual measures made before Herschel's time, and also with a set of measures made last year by Mr. Tebbutt (*Observatory*, vol. vii. p. 296) subsequently to the date of publication of the elements to which I refer.

| Epoch. | Observer. | Observed Pos. Angle. | Observed—Computed. |
|----------|-----------|-------------------------|--------------------|
| 1752.2 | Lacaille | 215.7 | +4.19 |
| 1822.0 | Fallows | 209.6 | —1.00 |
| 1824.0 | Brisbane | 215.4 | +3.77 |
| 1826.01 | Dunlop | 213.2 | +0.52 |
| 1830.01 | Johnson | 215.0 | +0.10 |
| 1831.00 | Taylor | 215.9 | +0.41 |
| 1832.16 | „ | 216.4 | +0.18 |
| 1884.533 | Tebbutt | 199.80 | —0.46 |

* In the Sloane MS. the impossibility of such latitudes seems to have occurred to the scribe, who has endeavoured to correct them by erasing the cypher, and so making them 30 and odd degrees, but in no case has the correct latitude been given.